



U.S. DEPARTMENT OF  
**ENERGY**



# SRS

## Occupational Radiation Protection Program

*Brief to SRS Citizen Advisory Board*

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# Outline

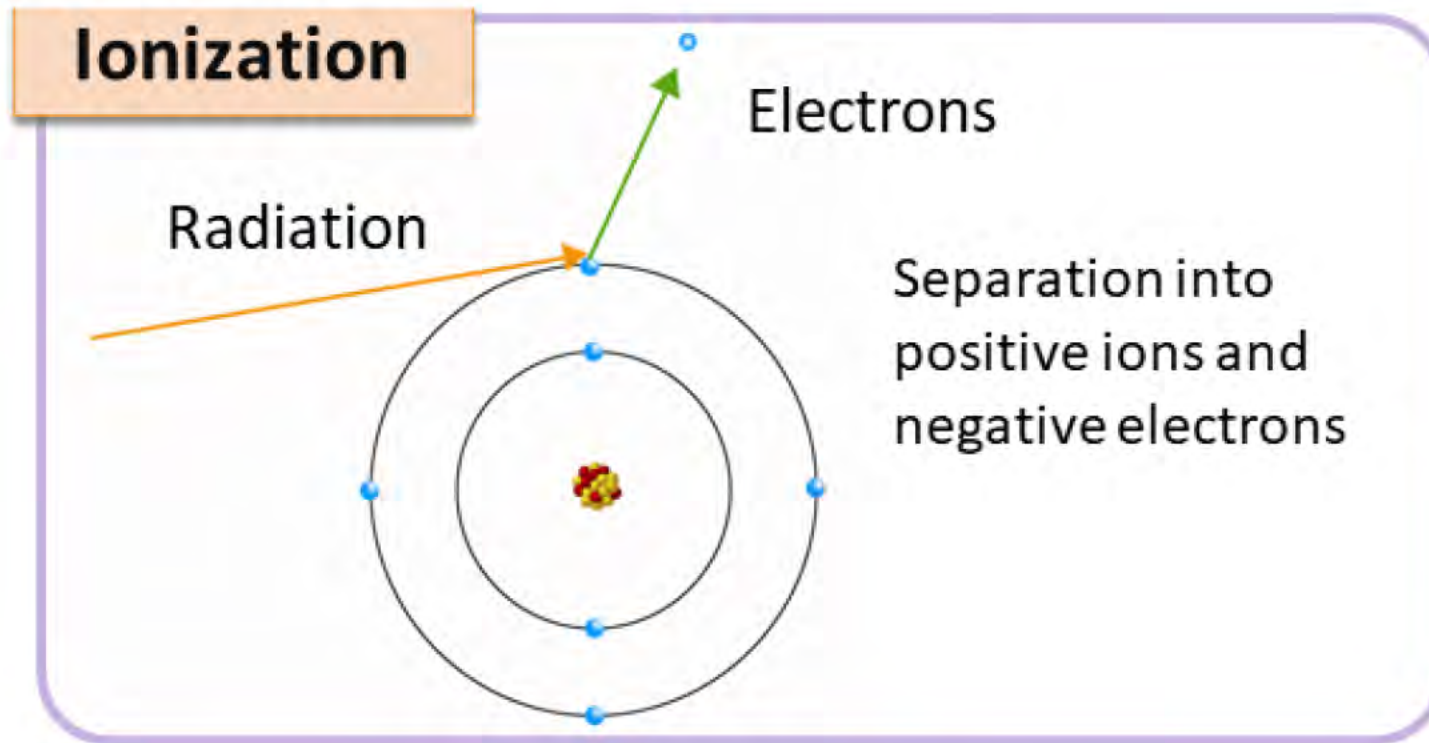
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- Brief introduction of Radiation
- Sources of Radiation
- Radiation at Savannah River Site
- Control of Exposure to Radiation at Savannah River Site

# What is Radiation?

## Definition:

- Ionizing Radiation
- Particles and electromagnetic waves with sufficient energy to cause ionization.





# Sources of Radiation

## Sources:

– Natural

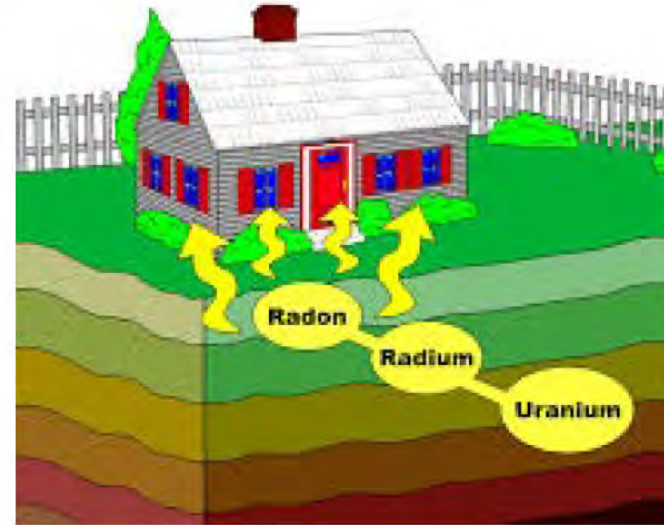


- Building materials



- Cosmos

- Radon



- Food



# Sources of Radiation

## Sources:

— Man Made



- Medical



- Nuclear energy

- Consumer products, industry

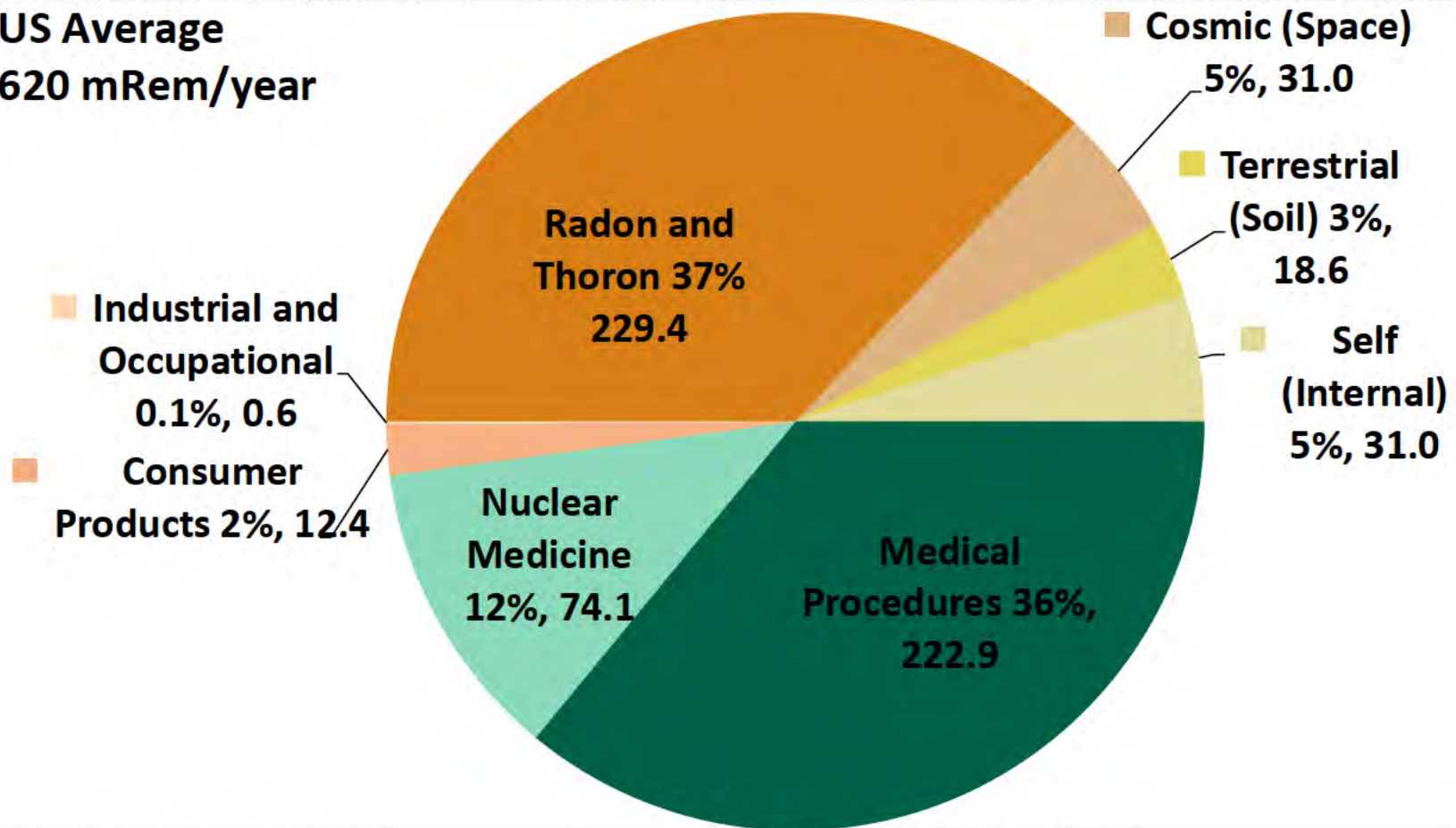


- Fallout



# Background Radiation

US Average  
620 mRem/year



Radon and Thoron 37%

Terrestrial (Soil) 3%

Medical Procedures 36%

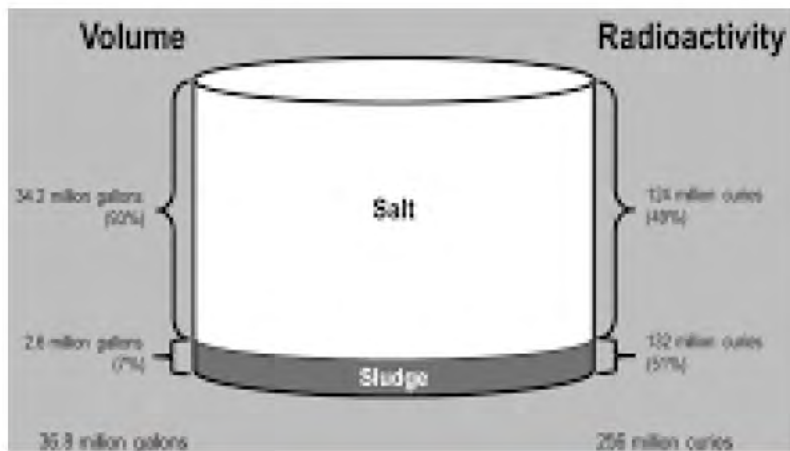
Cosmic (Space) 5%

Self (Internal) 5%

Nuclear Medicine 12%

# Sources of Radiation at SRS

## Storage, Processing, and Disposal of Liquid Waste and Nuclear Materials





# Types of Radiation at SRS

Type	Description	Properties	SRS Source (s)
Alpha ( $\alpha$ )	<ul style="list-style-type: none"><li>• 2 protons, 2 neutrons</li><li>• Charge +2</li><li>• Mass 4</li></ul>	<ul style="list-style-type: none"><li>• Few cm in air</li><li>• Stopped by paper or skin</li></ul>	Uranium, Plutonium
Beta ( $\beta$ )	<ul style="list-style-type: none"><li>• Electron</li><li>• Charge <math>\pm 1</math></li><li>• Mass 0.0005</li></ul>	<ul style="list-style-type: none"><li>• Several cm in air</li><li>• Stopped by low density material (aluminum or plexiglass)</li></ul>	Liquid waste
Gamma ( $\gamma$ )	<ul style="list-style-type: none"><li>• Photon/EM Wave</li><li>• Charge 0</li><li>• Mass 0</li></ul>	<ul style="list-style-type: none"><li>• Meters in air</li><li>• Stopped by high density material (such as Lead)</li></ul>	Principally liquid waste
Neutron ( $\eta$ )	<ul style="list-style-type: none"><li>• Neutron</li><li>• Charge 0</li><li>• Mass 1</li></ul>	<ul style="list-style-type: none"><li>• Meters in air</li><li>• Stopped by concrete, water</li></ul>	Special Nuclear Material



# Site's Guiding Principles for Personnel Radiation Exposure

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- As Low As is Reasonably Achievable (ALARA) - Control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, **taking into account social, technical, economic, practical, and public policy considerations.**
- Ensure site personnel exposure stays below legal and administrative limits.
- Time, Distance, Shielding.
- No exposure without a benefit.

# Radiation Protection at SRS

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## 1) Federal laws and regulations:

- 10 CFR 835 "Occupational Radiation Protection"

## 2) DOE Orders and Guidance Documents:

- DOE O 458.1 "Radiation Protection of the Public and the Environment"
- DOE-STD-1098 "Radiological Control"
- DOE G 441.1 "Radiation Protection Programs Guide..."

## 3) Site Manual

- 5Q manual and subtier procedures
- SRIP 441.1

## 4) Whole body dose limits for radiation workers

- 5000 mRem/year (regulatory limit)
- 2000 mRem/year (corporate DOE)
- 1000 mRem/year (Parsons)
- 500 mRem/year (SRNS, SRMC, Centerra, SREL contractors)
- 150 mRem/year (DOE-SR/NNSA-SRFO)
- 100 mRem/year (regulatory limit for Non-Radiation Worker/Visitor/Public)

## **Hierarchy of Controls**

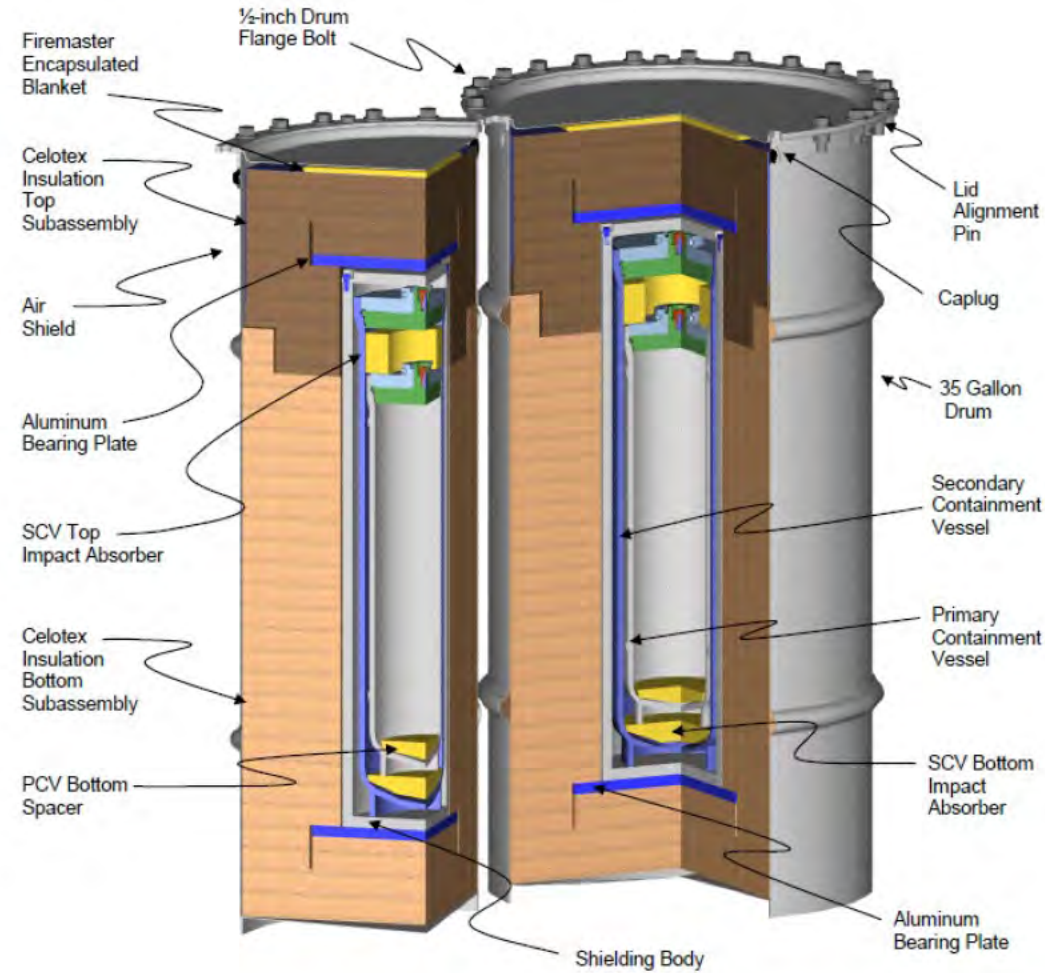
- Engineering Controls (EC)  
(shielding and distance)
- Administrative Controls (AC)  
(time and distance)
- Personnel Protection Equipment (PPE)  
(shielding)



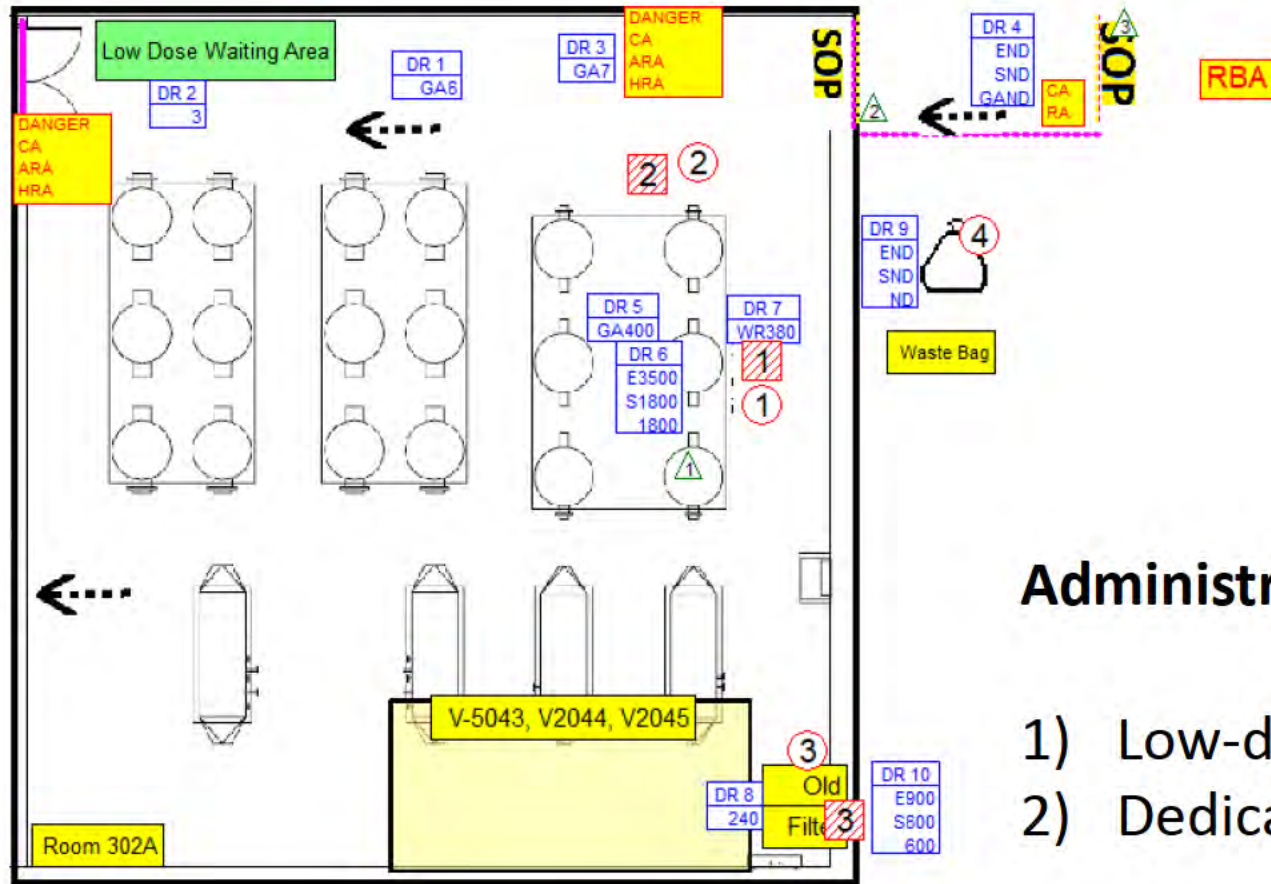
# SRS Radiation Protection Controls to Minimize Personnel Dose

## Engineering Control

Fabricated shielded containers to hold Pu Material in storage



# SRS Radiation Protection Controls to Minimize Personnel Dose



## Administrative Controls

- 1) Low-dose waiting area
- 2) Dedicated staging area



# SRS Radiation Protection Controls to Minimize Personnel Dose

## Engineering and Administrative Controls, Personal Protective Equipment

- 1) Water basin to store Spent Nuclear Fuel (EC)
- 2) Remote handling tools (EC)
- 3) Lift material at minimum level (AC)
- 4) Anti-contamination clothing (PPE)





# SRS Radiation Protection Controls to Minimize Personnel Dose

## Training commensurate with duties

- 1) General Employee Radiological Training
- 2) Radiological Worker Training I
- 3) Radiological Worker Training II
- 4) Other specialized training

Consolidated Annual Training (CAT) 2018

Web Based Training  
SRNS Site Training

General Employee Radiological Training (GERT)

### Radiation vs. Contamination

Click on each term to see an illustration:



**Ionizing Radiation**  
A type of energy, (particles or rays) emitted from radioactive atoms and some devices that can cause ionization. Exposure to radiation does not result in contamination.

Properly contained radioactive material can emit radiation and be an external dose hazard. Properly contained material is not a contamination hazard.

**Contamination**  
Radioactive material in an unwanted place. Improperly contained radioactive material can result in contamination and become both an external and internal dose hazard.

Type	Description
Fixed	<ul style="list-style-type: none"><li>• Cannot be removed by casual contact.</li><li>• May be released when the surface is disturbed (buffing, grinding, using volatile liquids for cleaning, etc.).</li><li>• Over time, may become loose or removable.</li></ul>
Removable / Transferable	<ul style="list-style-type: none"><li>• May be transferred by casual contact.</li><li>• Any object that makes contact with this type may in turn become contaminated. This is known as "cross-contamination".</li></ul>
Airborne	Radioactive contamination suspended in air in the form of particles, vapors, and/or gases.

MENU

HELP

BOOKMARK

OBJECTIVES

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CONTACTS

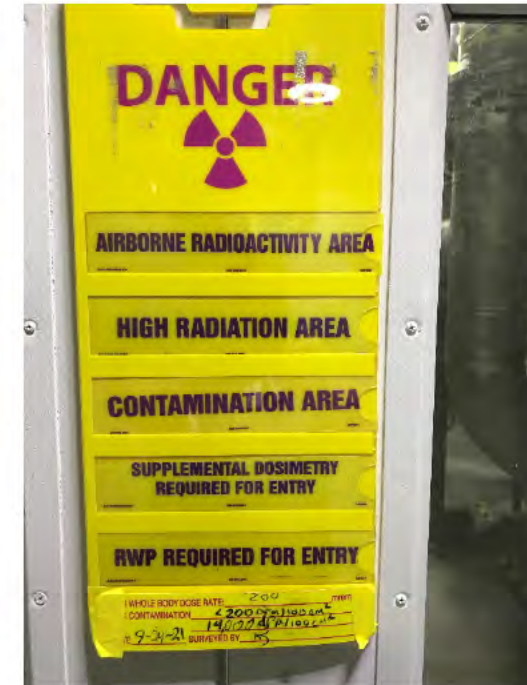
DOCUMENTS

GLOSSARY

EXIT

# SRS Radiation Protection Controls to Minimize Personnel Dose

## Postings and barricades:





# SRS Radiation Protection Controls to Minimize Personnel Dose

## Monitoring

- Personal Dosimeters
- Bioassays
- Area and Airborne Radiation Monitors
- Remote Monitoring
- Contamination Monitors



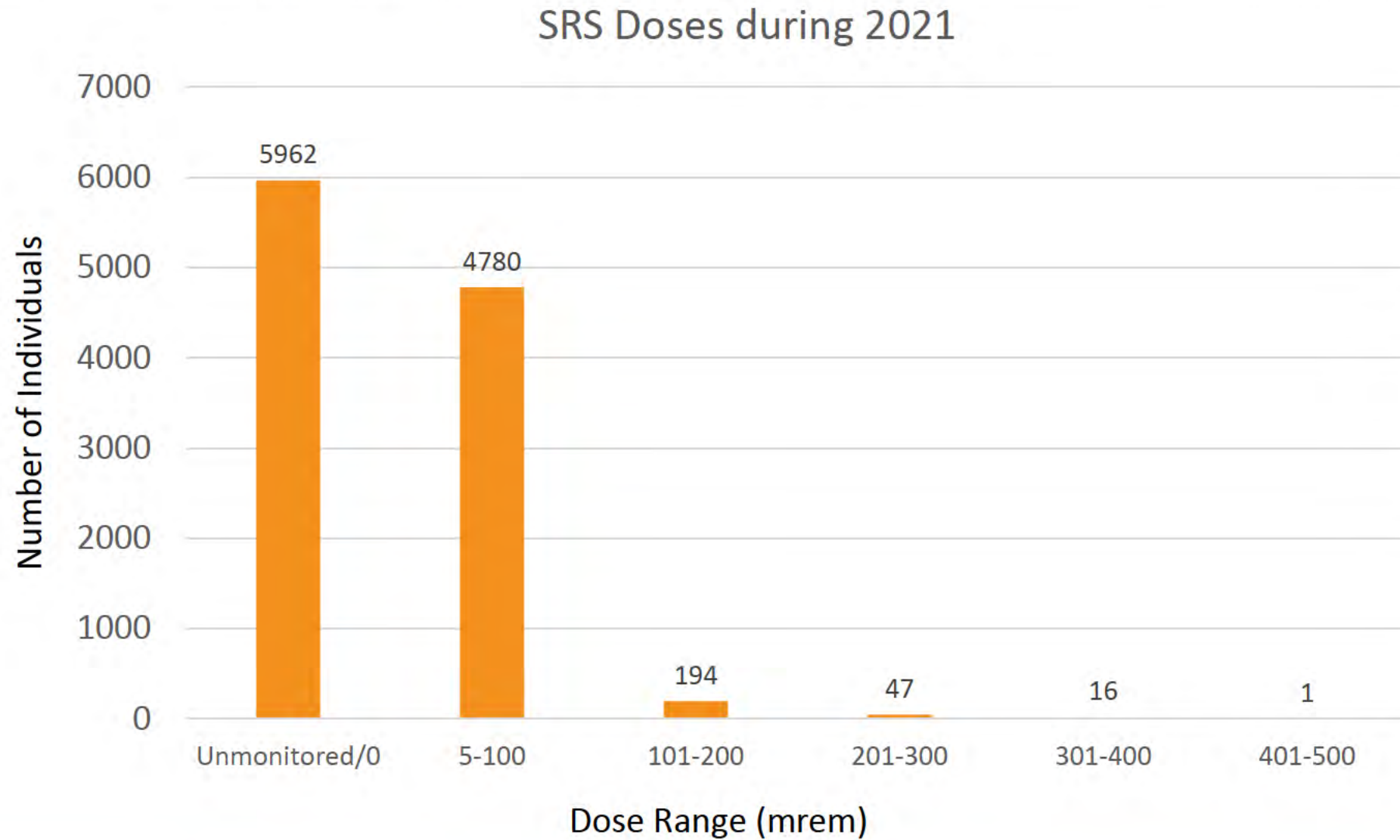


## Record Keeping

- Maintain Records of Individual Annual and Lifetime Dose
- Training and Qualification Records
- Radiation Survey Records
- Instrument Calibration, Maintenance, Quality Assurance
- Audits

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# 2021 Doses at SRS



# Summary

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- Radiation exposure at SRS is well understood and easily measurable.
- Numerous engineered and administrative controls are in place to minimize worker exposure.
- Posting and barricades control access to radiation work areas.
- Regular monitoring to characterize and note any changes radiological conditions.
- Worker training/qualification required before they can perform tasks in radiation and nuclear material areas.
- ALARA. No exposure without a benefit.